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AUTHOR Levenstein, Phyllis; Phillips, Juliet R.
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ABSTRACT

This report examines the Family Cognitive Profile Study which provided for the collection and analysis of data regarding the IQ gains of children enrolled in the Mother Child Home Program (MCHP). The existence of siblings among the subjects of the MCHP was noted by the Verbal Interaction Project (VIP), the research organization responsible for MCHP, as a potential source of difficulty in evaluating the program's effectiveness. Since MCHP reaches the child through the intervention of the mother, it was expected that some dependency existed between the IQ gains of siblings. Four "mother exposure" hypotheses, based on the premise that continued exposure to the program changes the mother's behavior toward her children, were formulated to guide the research. Statistical procedures used in the study were also evaluated. The data was drawn from the IQ scores of more than 300 children who were enrolled for at least one year in MCHP. The investigation of the "mother exposure" hypotheses was hampered by methodological obstacles, and only one of the four hypotheses was confirmed. Appendixes compose approximately one-third of the document. (SDH)

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VERBAL INTERACTION PROJECT

Mother-Child Home Program

Family Cognitive Profile Study

Juliet R. Phillips
Research Associate

Final Report to the Foundation for Child Development

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Phyllis Levenstein
Principal Investigator

Family Service Association of Nassau County and State University of New York at Stony Brook

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I. OVERVIEW OF THE VERBAL INTERACTION PROJECT

The Verbal Interaction Project (VIP) is the research organization responsible for the Mother-Child Home Program (MCHP). This program is designed to promote the success of children in mastering the basic skills taught in the primary grades. The program is aimed at children from economically deprived families because these are the children most likely to experience difficulty in benefitting from school instruction. The Verbal Interaction Project holds that this difficulty stems from insufficient verbal interaction in the child's home environment during his preschool years. The Mother-Child Home Program attempts to increase the verbal interaction between family members, especially between mother and child.

The child enters the MCHP at the age of two and may continue to receive treatment for two years, or until the age of four. The VIP conducts intelligence tests before the program starts, after the first year of the program (Program I) and after the second year of the program (Program II). These IQ scores help in assessing the program's effectiveness. Although the ultimate goal of the program is to help the children perform well in school, the immediate goal is to raise their IQ level, because IQ is strongly associated with school performance.

The program is delivered to each child individually through sessions conducted in the child's home twice a week. "Home sessions" are one half hour long. They are conducted by a "Toy Demonstrator" (TD), who is trained at the Program Center. Each week the TD brings the child a carefully selected toy, which is the focus of the sessions. The toys become the property of the child and remain in the home for further use. The TD uses the toys to stimulate play and verbal interaction with the child.

Verbal expression organized around play is an important vehicle for cognitive growth. During play an adult has many opportunities to introduce new concepts such as form, color, size and function. She can engage the child in conversation and stimulate his imagination. She

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can encourage him to discuss events and relationships in the games and in the child's life.

A major feature of the Mother-Child Home Program is the participation of the mother in the home sessions. We believe that the mother plays a crucial role in the cognitive growth of a preschool child and that any program which seeks to promote growth must reach both the mother and the child. Other family members are also welcome to participate.

The mother has the opportunity to observe and, if she wishes, to adopt the techniques of verbal interaction used by the TD. She is given no specific instructions, but she is encouraged to play with the child both during and between sessions. The TD retires into the background in the sessions as soon as the mother is willing to take a major role. If the mother is receptive, the techniques of the Mother-Child Home Program become a regular part of the home environment. The Verbal Interaction Project maintains that these techniques help to prepare children for the demands of formal education.

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II. ORIGIN OF THE FAMILY COGNITIVE PROFILE STUDY

The MCHP has been in operation since 1967 and has enjoyed both critical and popular success. The families served have been very enthusiastic and have in many instances enrolled more than one child in the program.

The current investigator noted that the existence of siblings among the subjects of the VIP is a potential source of difficulty in evaluating the effectiveness of the MCHP. The difficulty arises in the following way.

After each year of the program the VIP checks the effectiveness of the MCHP in raising the IQs of the subjects. The t-test is the tool used to decide whether the increase in the IQs of the subjects is statistically significant. Every year there has been a highly significant increase in IQ among the subjects in Program I(first year) and also among the subjects in Program II (second year). The effectiveness of the program is thus confirmed by statistical means, and the excellent reputation of the program rests in part upon this confirmation.

The t-test rests on certain statistical assumptions. If these assumptions are not met, the results of the t-test will not be valid. One of these assumptions is that each datum which enters into the t-test is independent of every other datum. In our case, each subject's IQ gain must be statistically independent of every other subject's IQ gain.

The assumption of independence may be violated because some of our subjects are siblings and we have reason to expect dependency between the IQ gains of siblings. The MCHP reaches the child through the mother. The amount the child benefits from the program depends on his mother's willingness and skill in applying the techniques of the MCHP. Because siblings have the same mother, the amount they gain in the program may be similar.

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How can we check whether the gains of siblings are in fact similar? One way is to compute the correlation between the siblings' gains. If there is a strong positive correlation, subjects who gain well have siblings who also gain well, and subjects who gain poorly have siblings who also gain poorly. A positive correlation would support our assumption that mothers are crucial in affecting IQ gains, and it would also indicate a need to reassess the statistical significance of the IQ gains brought about by the MCHP, since it would show that there is dependence among the gains of the VIP subjects.

The prediction of a positive correlation between gains of sibs initiated the Family Cognitive Profile Study. One prediction about the gains of siblings soon gave rise to others. We predicted similarities in the IQ gains of sibs because sibs have the same mother. But the mother's skills may change from year to year. If the IQ gains of subjects depends on the mother's skills in applying the techniques of the MCHP, then the more experience the mother has with the program, the more her children should gain. For instance, when the second child from a family enters the program, his mother has already had a year or two of exposure to the program's Techniques. The second child should therefore gain more during the program than his older sibling did. We therefore predicted systematic differences in IQ gain between sibs. We called these predictions the "mother exposure" hypotheses, because they are based on the premise that continued exposure to the program changes the mother's behavior toward her children.

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III. HYPOTHESES

We have stated that we expect both similarities and differences in the IQ gains of first and second sibs. Our expectations of similarities in gains gave rise to one hypothesis; our expectation of differences gave rise to three hypotheses. We will now state each hypothesis formally, give its underlying rationale, and discuss the implications arising from its confirmation or disconfirmation.

Hypothesis I: There is a positive correlation between the gain in IQ of sibling 1 in his first year of the program[1] and the gain in IQ of sibling 2 in his first year of the program.

If the gain of a child is similar to the gain of his sib, then the gains of the siblings should be positively correlated. The more similar is the child's gain to the gain of his sib, the stronger the correlation will be.

A positive correlation between sibs' gains would imply that there is some characteristic of the family helping to determine the subjects' gains; this characteristic may well be the mother's skill in using the techniques provided by the program. Thus a positive correlation would tend to support the role of the mother in cognitive intervention.

A strong correlation in either direction would indicate that the t-tests computed on gains of subjects in the Verbal Interaction Project are based on data which are not wholely independent. Therefore, if we find a correlation, we must try to assess its influence on the t-test and if necessary adjust the statistical procedures of the VIP[2] to take the correlation into account.

If we do not find the correlation we are looking for, we will be reassured about the statistical procedures of the VIP[3], but we will have to reconsider our assumption that the mother acts as a mediator between the program and the child.

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The remaining ~~three~~ hypotheses are concerned with differences in IQ gains between siblings. We anticipate differences in IQ gain between sibs as the mother becomes practiced in verbal interaction techniques. The mother's prior experience with the program may make a difference to the child before, during and after his participation in the program.

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Hypothesis 2: The more experience the mother has had with the Mother-Child Home Program, the higher the child's IQ will be before he enters the program (pretest IQ score)[4].

In Hypothesis 2 we predict downward diffusion of program effects. Downward diffusion may be defined as the gain in IQ which a child experiences as the indirect result of his older sibling's participation in the program. We expect downward diffusion because the mother will probably use her new skills with all her children, not just with the one formally enrolled in the program.

If we find a positive association between the exposure of the mother to the program and the one test score of her child, we may interpret this as evidence of downward diffusion and support for the role of the mother in promoting IQ gains among her children.

Hypothesis 3: The more experience the mother has had with the program, the more the child will gain during Program I.

If the mother is more skilled with the second child than she was with the first child, then the second child should make greater gains during the program than his older sib did.

If we find a positive association between the mother's exposure to the program and the IQ gains of her child, we may conclude that the mother's skills in stimulating verbal interaction improve as a result of her experience with the program. This finding would also underscore the importance of the mother's role in the cognitive growth of her children.

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<u>Hypothesis 4:</u> The more experience a mother has with the Mother-Child Home Program <u>after</u> the child leaves the program, the more of his gains that child will retain.

In Hypothesis 4 we predict upward diffusion of program effects. Upward diffusion may be defined as the benefit which a child receives from his younger sibling's participation in the program. We expect better retention of IQ gains as the result of upward diffusion. If the mother is still actively involved in the program because her younger child is participating, we may expect that her skills are increasing or at least being maintained, when otherwise they might be forgotten. The older sib should therefore retain his IQ gains better than a child whose family has no further contact with the program.[5]

A positive association between mother exposure and the child's retention of gains may be interpreted as evidence of upward diffusion and is also supportive evidence for the role of the mother in her children's IQ gain.

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IV. METHOD OF TESTING THE HYPOTHESES

Subjects

The data for this study were drawn from the IQ scores of more than 300 children tested at the Verbal Interaction Project. Most of the children were enrolled in the program for at least one year; many received treatment for two years. Children enrolled in the program will be referred to as "experimental subjects". All experimental subjects were tested before entering the program (pretest) and after Program I (posttest I)[6]. Subjects who took Program II were also tested after Program II (posttest II). Most of the children were also tested several times after leaving the program (Follow-up testing).

Most experimental subjects enter the program at age 2. During the first year the program was in operation (1967-1968), 3-year olds were also admitted. These subjects were not given the option of a second year in the program.[7]

Children tested at the VIP but not enrolled in the MCHP will be referred to as "control subjects". Four groups of control subjects were tested in the period 1967-1972. The groups were designated C_1, C_2, C_3, and C_4. All of these subjects were tested initially, as if for pretest. Subjects in C_1 and C_3 and most subjects in C_2 were tested again after one year. Some subjects in C_2 and C_3 were tested a third time after two years. All the control subjects were included in the Follow-up testing along with the experimental subjects. Some control subjects had siblings who were also control subjects; some had siblings in the experimental program.

Organizing the data

The first task of the Family Cognitive Profile Study was to organize these diverse data in a fashion useful to the study. In order to test the hypotheses, we needed to identify the members of each family and to record the experience of each family member with the program. To accomplish these tasks, the investigator devised a form[8] which identifies the relationships between family members, what types of experiences they have had with the program, when these experiences took place, and the results of all IQ tests.

Filling out this form was often problematic. The required information

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was not previously recorded in one place and sometimes was not recorded at all. Often the family relationships were complex; for instance a grandmother may have attended home sessions in place of the mother who worked, or a cousin may have lived in the house for a while. The forms were completed with the help of the program staff. Their cooperation was much appreciated.

The data on each subject were then transferred to an IBM card (see example on page 36). These IBM cards facilitated sorting of information. For instance, we used them to find out which families had two children in the program, which subjects were enrolled in the program for two years, and so on. The cards were also fed directly into the computer to calculate correlations and t-tests.

Testing the Hypotheses

Testing Hypothesis 1: There is a positive correlation between the IQ gains of sibs during Program I.

This hypothesis was tested on 36 pairs of siblings, each of whom had at least one year of experience in the program.[9] We computed the correlation between the IQ gain of each subject and the IQ gain of his sib and found a correlation of .17, which is not statistically different from zero.[10] (See Figure 1).

Our failure to confirm the first hypothesis suggests that the mother is not a crucial link between the program and the child. Since the remaining three hypotheses to be tested are based on the assumption that the mother plays an important role, there would appear to be no reason to pursue them. However, because the disconfirmation of Hypothesis 1 was so counter-intuitive, we examined the data more carefully to determine whether this result was genuine or artificial.

Results of the inquiry into the failure to confirm Hypothesis 1. We first graphed our data so they could be inspected more carefully. Figure 1 shows the scatter diagram of the IQ gains of sib 1 (older sib) compared with the IQ gains of sib 2 (younger sib). The average IQ gain of sib 1 (19.3) and

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the average IQ gain of sib 2 (10.8) are marked on the graph, thus dividing it into four quadrants (see Figure 1). If there were a strong positive correlation between the IQ gains of sibs, most of the data points in Figure I would appear in Quadrants II and III, and very few would appear in Quadrants I and IV.

We can readily observe that there are few data points in Quadrant I;[11] on the other hand, there are several points in Quadrant IV. These later points were not predicted by our hypothesis and they account for the low correlation between the gains of sib 1 and the gains of sib 2.

The data points in Quadrant IV represent pairs of siblings where the older sib did very well in the program and the younger sib did poorly. The existence of such pairs is surprising. What might account for them? If we can explain them, we can also explain why we were not able to confirm Hypothesis 1.

In examining the subjects in Quadrant IV, we found that they have a distinctive characteristic. In this group of 10 pairs, the younger sibs started off the program with IQs very much higher than their older sibs' IQs were when they started the program. On entering the program, the older sibs had an average IQ of 81.6; the younger sibs had an average IQ of 97.0 when they entered the program. In subsequent paragraphs we will discuss the difference between the pretest IQ score of the older sib and the pretest IQ score of the younger sib; for convenience we will call this difference "pretest differential" or "pd".

We had already predicted the existence of a pretest differential because of the downward diffusion of program effects from the older sib to the younger sib (See Hypothesis 2). We therefore interpreted the pretest differential which we found among the subjects in Quadrant IV as evidence of downward diffusion. In other words, when the younger sibs started their program, their IQs had already been raised by indirect exposure to the program.[12]

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We will now show how downward diffusion, manifested in a pretest differential, helps to explain the presence of subjects in Quadrant IV--that is, pairs of sibs in which the older sib gains well and the younger sib gains poorly.

Figure 7 shows the relationships between the gains of second sibs and the pretest differential. When the pretest differential is above 17, the second sib gains at most 10 points. In contrast, when pd is moderately high (5-17), the second sibs may gain as much as 40 points. We concluded from these observations that sib 2 will gain little in Program I if his pretest IQ is much higher than his sib's pretest IQ.[13] The high pretest differentials found among the pairs of siblings in Quadrant IV may therefore explain the low gains of the younger sibs.

We can now explain clearly why we found a low correlation between the IQ gains of a child and the IQ gains of his sib. The low correlation resulted from the presence of seven subjects[14] who gained many IQ points during the program and had younger sibs who gained few IQ points. These younger sibs benefited a great deal from their older sibs' involvement in the program, even <u>before</u> the younger sibs entered the program. By the time the younger sibs were formally enrolled, their IQs were 21.3 points higher than their older sibs' IQs had been when they entered the program. This large pretest differential shows that the younger sibs did most of their growing before they entered the program. Consequently they gained very little <u>after</u> they entered the program. Their low gains, associated with the high gains of their sibs, cancelled out the positive correlation between IQ gains of the other sibs in the program.

<u>Implications of the failure to confirm Hypothesis 1.</u> The lack of a correlation between the gains of sib 1 and the gains of sib 2 does not necessarily imply independence between siblings' overall responses to the program. Since the impact of the program on the younger sib starts <u>before</u> he enters the program, the number of IQ points he gains <u>during</u> Program I does not accurately reflect his total response to the program. The total gains of the second sib include both the gains during the program and the gains prior to the

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program. If we could measure the total gains of both sibs we might well find a correlation between them. Because we cannot measure total gains, we cannot draw conclusions about the role the mother plays in promoting the IQ gains of her children.[15]

Our ignorance of the total gains of second sibs does not affect our conclusions about the validity of the t-tests used by the VIP. The data which are entered into the t-test are the IQ gains experienced during Program I. The t-tests will be valid if these gains are independent of each other. We have seen that there is no correlation between the gains of sibs, therefore the t-test is free of bias from that source.

Testing Hypothesis 2: The more experience the mother has had with the Mother-Child Home Program, the higher the child's IQ will be before he enters the program (pretest score).

Hypothesis 2 had already been tested on a subsample of the available data, namely on the 25 pairs of siblings examined under Hypothesis I. The older sibs in this sample have mothers who are inexperienced in the program, while the younger sibs have experienced mothers. Therefore, for these 25 pairs, Hypothesis 2 may be rephrased as follows: "The pretest score of second sibs is higher than the pretest score of first sibs". When the hypothesis was tested in this form it was supported;[16] the mean pretest score of second sibs was 8.2 points higher than the mean pretest score of first sibs.

We also tested Hypothesis 2 in its original form. We compared the pretest scores of all subjects whose mothers had not had previous MCHP experience with the pretest scores of all subjects with experienced mothers. Our previous finding was upheld.[17] On the average, children with experienced mothers had a pretest score 6.4 points higher than children with inexperienced mothers.[18]

Testing Hypothesis 3: The more experience the mother has had with the program, the more the child will gain during Program I.

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The findings in Hypothesis 1 have shown Hypothesis 3 to be false. Children of experienced mothers gain less than children of inexperienced mothers during Program I. This is true because children of experienced mothers are affected by downward diffusion before they enter the program. We have seen that downward diffusion promotes IQ gains <u>before</u> the child enters the program but reduces gains <u>during</u> the program.

When we formulated Hypothesis 3, we had no reason to suspect that downward diffusion would influence gains <u>during</u> the program either by increasing them or by reducing them. We assumed that gains during the program were independent of prior gains. This assumption has proved false, and so has Hypothesis 3.

<u>Testing Hypothesis 4:</u> The more experience a mother has with the MCHP <u>after</u> the child leaves the program, the more of his gains the child will retain.

The data appropriate for testing this hypothesis have become available in sufficient quantity only since June 1973. The testing of this hypothesis has therefore not been carried out and is one of the important tasks remaining in the study.

Pretest Differential: further analysis

The effects of diffusion as manifested in the pretest differential emerged as the major finding of the study. The second half of the past year was devoted mainly to confirming and elucidating this finding. First, we wanted to establish the validity of the pretest differential as an indicator of downward diffusion. It is possible that the differential is a statistical artifact of some kind and not a reflection of a real change in children's cognitive processes. We wanted to rule out this possibility.

Second, we wanted to know whether the pretest differential conferred any ultimate advantage on the second sibs. Did their low gains subsequent to entering the program balance their high gains prior to entering the program, so that in the long run they gained no more than first sibs? Or did

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second sibs with high pretest differentials eventually end up with higher scores than their brothers and sisters? In other words, does the downward diffusion of the program exert a lasting positive effect?

Third, we wanted to understand more clearly what makes some children benefit so much from diffusion and others so little. We wanted to identify the sources of variation in the pretest differential, which ranges from +39 to -40, a very wide range indeed. What circumstances promote downward diffusion and what circumstances detract?

Fourth, we wanted to know why the subjects with high pretest differential did not gain much during the program. Intuition did not lead us to expect this result. The stimulation of the Mother-Child Home Program is of a very general type, designed to promote growth at any level. Subjects of a wide range of pretest IQs have been found to benefit equally from the program (see Figure 2). Why then should an increase in IQ before the onset of the program result in less growth after the onset of the program?

We will treat in turn each of the four problems introduced above.

1. Validity of the pretest differential as an indicator of diffusion effects.

The first question which we will pose is whether the pretest differential is the result of regression to the mean. Regression to the mean is a traditional argument used to refute studies showing how IQ may be improved (Hunt, 1961). Because of the historical importance of this criticism, we have taken special pains to show that the pretest differential is not due to regression to the mean.

The concept of regression to the mean is a subtle one, which may be clarified with an illustration. There are few men as tall as 6'10". If a man of this height has a son, the chances are pretty good that he will be shorter than 6'10". This has nothing to do with either genes or nutrition. It is just unlikely that two extremely tall men would accidentally end up in the same family, since there are so few extremely tall men in the population.

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Likewise, a man who is 4'8" tall is very likely to have a son who is taller than he is. If the father's height is far from the mean, the son's height is usually closer to the mean. This is the meaning of the phrase "regression to the mean".

Suppose you wanted to test the hypothesis that by eating cabbage a man can insure that his son will be taller than he is. If you collect together a group of very short men and feed them all cabbage until they have sons, the chances are the sons will grow up to be taller than their fathers. This has nothing to do with cabbage.

Likewise, if you collect together a group of children with very low IQs and subject them to the training of your choice, the chances are that their siblings will have higher IQs than their own. This may have nothing to do with the training. It is expected purely on the basis of the distribution of IQs in the population.

One way to test whether the pretest differential is the result of regression to the mean or the result of the Mother-Child Home Program is to use a control group in which the sibs are tested but are not enrolled in the MCHP. If we find the same pretest differential in the control group as in the experimental group, then clearly the pretest differential cannot result from downward diffusion of the MCHP. On the other hand, if no pretest differential is found in the control group, then pd clearly cannot result from regression to the mean but may well be the product of downward diffusion of the program.

We have available two groups which might serve as controls for our purpose. First, among the experimental subjects of the VIP are eleven pairs of siblings in which both sibs entered the program in the same year. We have called them "simultaneous pairs". Because both sibs were pretested before either had enrolled in the program, neither sib could benefit from downward diffusion. Consequently we do not expect a pretest differential among simultaneous pairs. If we find a pretest differential, this will be evidence that pd is <u>not</u> the result of diffusion; it may instead result from regression to the mean. If we find no pd, this will be evidence that pd is <u>not</u> the result of regression to the mean; instead it may be the result of downward diffusion.

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No pretest differential was found among the simultaneous pairs. The mean difference between the pretest IQs of first and second sibs is 3.4, which is not significantly different from zero.[19] We concluded that pd is not the result of regression to the mean.

The second control group is composed of fourteen control subjects and their younger siblings.[20] Since the older sibs were not enrolled in the MCHP, the pretest scores of the younger sibs could not be affected by downward diffusion. As in the first control group, if there is no pretest differential among these subjects we may conclude that pd is not the result of regression to the mean and instead is likely to be the result of downward diffusion.

No pretest differential was found in the second control group. The mean difference between the pretest IQs of first and second sibs is 2.6, which is not significantly different from zero.[21] We concluded once again that pd is not the result of regression to the mean.

In conclusion, the evidence from control subjects confirms that pd cannot be explained by regression to the mean and is probably the result of downward diffusion.

We have found four other ways to show that the pretest differential is not caused by regression to the mean. These four methods, described below, are all based on comparisons of the distribution of sib 1's pretest scores with the distribution of sib 2's pretest scores.

a. Mean values of pretest scores. If the pretest differential is purely the result of regression to the mean, then the pretest scores of first sibs and the pretest scores of second sibs are samples from the same population of pretest scores. Therefore, under the hypothesis of regression to the mean, first sibs are expected to have the same mean pretest score as second sibs. A significant difference between the mean IQ of first sibs and the mean IQ of second sibs would then indicate that the pretest differential is not caused by regression to the mean.

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We have already seen that the mean pretest IQ of second sibs is 8.2 points higher than the mean pretest IQ of first sibs; therefore the pretest differential is not caused by regression to the mean but is instead caused in some way by the Mother-Child Home Program.

b. Range of pretest scores. Under the hypothesis of regression to the mean we expect that the range of pretest scores of first sibs is identical with the range of pretest scores of second sibs. The graphs in Figure 3 show the distributions of the first and second sibs before and after the first year of the program and after the second year of the program. Note that the range of pretest scores of second sibs is much smaller than the range of pretest scores of the first sibs. We conclude that the pretest differential is not caused solely by regression to the mean.

c. Normal distribution of the pretest differential. Under the hypothesis of regression to the mean, we expect the distribution of pretest differentials to be approximately normal in shape.[22] In the normal distribution the majority of cases fall at or near the mean and the cases are distributed symmetrically around the mean. In contrast the distribution of differences between sibs' pretests is markedly skewed toward the positive and has only one case in the range between -9 and +5 (see Figure 6). We conclude that the pd distribution cannot be explained by regression to the mean.

d. Relationships of pd with other characteristics of the subjects. If the pretest differential is merely a statistical artifact, then we expect the pretests of both sibs to relate to their other characteristics in the same way. For instance, we observe that there is a strong correlation ($r=.82$, $p < .001$) between the pretest scores of first sibs and their posttest scores (see Figure 4). This high correlation implies that most first sibs gain a fairly constant amount during Program I, regardless of their initial IQ. If the pretest differential is a statistical artifact, then the same finding should hold for second sibs. Second sibs should gain a fairly constant amount during Program I, and the correlation between their pretest and posttest scores should also be about .82.

Figure 5 shows the plot of the pretest scores of second sibs in relation to their posttest scores. The correlation between these scores

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(r=.50), while still positive, is much smaller than expected.[23] We conclude that the response of second sibs to Program I is much less constant than the response of first sibs.

The difference between the correlations is further evidence that the pretest differential is not caused by regression to the mean. It is caused by a real diffusion of the program from older sib to younger. This diffusion raises the pretest scores of the younger sibs and also reduces their gains during Program I, thereby altering the usually constant relationship between pretest and posttest scores.

In sum we have found six sources of evidence that the pretest differential cannot be explained purely by regression to the mean.

2. Long range effects of downward diffusion Diffusion increases the pretest score of a child but it also decreases his IQ gains during the program. What is the long range effect of downward diffusion on IQ level? Do second sibs end up with the same score, on the average, as first sibs? Or do they gain some ultimate advantage from downward diffusion? Figure 3 shows the distributions of IQ scores for first and second sibs before the program starts, after one year inthe program, and after two years in the program.[24] The graph indicates that the scores of first and second sibs are virtually identical after one year in the program, but that second sibs seem to have gained slightly more than first sibs after two years in the program.

In determining the difference in IQ between first and second sibs at posttest II, we must take into account the fact that some first sibs and some second sibs have dropped out of the program after a year. In a subsequent analysis we will restrict our examination to the 15 pairs of siblings who have both had two years of the program. If we find a significant difference, we will also examine follow-up data to see if the difference is maintained.[25] If we find no lasting difference in IQ between these first and second sibs, we may conclude that intervention at the age of two is optimal and that earlier intervention would probably result in

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no lasting advantage. Conversely, if we find that second sibs gain more than first sibs, this would provide evidence in support of those psychologists and educators who claim that you cannot start too early in repairing environmental deficits.

3. Factors affecting the size of the pretest differential.[26] One factor affecting the size of the pretest differential is the number of IQ points gained by the first sib during Program I. When the first sib gains less than average in the program, the mean pretest differential (0.9 IQ points) is not significantly different from zero.[27] On the other hand, when the first sib gains more than average, the mean pretest differential (14.0 IQ points) is statistically significant.[28] Therefore the level of gains made by the first sib is related to the amount gained by the second sib before he enters the program (see Figure 6).

In other words, if the first sib gains more than the average amount for first sibs, the chances are that his younger sib is gaining at the same time. If the first sib gains less than the average amount for first sibs, the younger sib appears to be unaffected by the program before he is formally enrolled in it. This relationship between the first sib's gains during Program I and the second sib's gains before Program I suggests that there is something in the environment influencing the children's receptiveness. This environmental factor could be the mother's skill in engaging the children in verbal interaction.

Another factor which may affect the size of the pretest differential is the presence of the younger sib at the home sessions during the time when only the older sib is enrolled in the program. The MChP has a policy of including all interested family members in the sessions.[29] Since younger children may be regular participants in home sessions intended for their older siblings, it is possible that the heightened IQ of a younger sib at pretest is due directly to his earlier exposure to the program rather than to the skills his mother has developed during her prior exposure to the program. We need to assess separately the effects of the child's exposure to the program and the effects of his mother's exposure to the program.

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We tried to separate these two effects by comparing younger sibs who had direct exposure to the program with younger sibs who had no direct exposure to the program before they were formally enrolled in it.[30] Since subjects start the program at age 2 and complete it at age 4, a sib 3 years younger than the enrolled child would be too young to participate personally in the home sessions of the older sib. On the other hand, a sib who is one year younger than the enrolled child is a toddler when his older sib enters the program, and his presence at the sessions is practically assured. If "child exposure" accounts for the pd then we should find the pd only when the sibs are one or two years apart. On the other hand, if "mother exposure" accounts for the pd, then we should find the pd even when the age difference of the sibs is three or four years. So far, the evidence bearing on the relative importance of "child exposure" versus "mother exposure" is inconclusive. In the future we hope to investigate this question further as more data become available.

As of now, we have some tentative evidence that the mother's exposure to the program is important in raising the child's IQ. First, children who do poorly in the program have siblings who do poorly (see Figure 1). Second, on the average we find a positive pretest differential only when the first sib has gained more than average in Program I. Both of these observations suggest that the mother influences her children's response to the program.

4. Reductions in the gains of second sibs during Program I as a result of downward diffusion At first we attributed the low gains of the second sibs to their high pretest scores. It is plausible that subjects with low IQs will gain more from the program than subjects with high IQs. Since diffusion tends to raise the younger sib's IQ to a high level before he enters the program, his high IQ score on entering the program may explain his low gains during the program.

Later, however, we discovered that the pretest IQ does not ordinarily determine the amount gained during the program (see Figure 2). A subject with a pretest score of 120 is just as likely to gain a given amount as a subject with a pretest score of 60. Therefore we had to account for the

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low gains of second sibs in some other way. Two alternative explanations seemed plausible.

a. Second sibs gain little during Program I because of competition from the older sibling during home sessions.

b. Second sibs gain little during Program I because they have gained as much as they can before the program.[31]

We will discuss each alternative in turn.

<u>a. Competition during home sessions.</u> When two children in the home are both enrolled in the program, only one home session is held for both children. This is true whether both children are in Program I or whether one child is in Program I and the other in Program II. It is possible that the children compete for the attention of the mother and the Toy Demonstrator. If the older child generally receives a greater share of the attention, the younger child may suffer a reduction in the gains he would otherwise achieve during Program I.

If competition is an important factor in explaining the low gains of second sibs, we would expect to find low gains primarily in two groups of subjects. The first group is composed of "simultaneous pairs", or pairs where both sibs entered Program I in the same year. The second group is composed of "overlapping pairs", or pairs where sib 2 is in Program I when sib 1 is in Program II. For both of these groups, the average gain of sib 2 is substantially less than the average gain of sib 1 (see Table 1). This information appears to be consistent with the idea that the low gains of the second sib are caused by competition between the sibs during home sessions.

We have previously seen that the low gains of second sibs are associated with a high pretest differential. If most of the pairs with a high pretest differential were also overlapping pairs, then it might appear that the low gains of the second sibs were due to the high pretest differential when in fact they were due to the competition between the sibs.

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It is in fact true that most of the pairs with high pd are also overlapping pairs (see Table 1). How can we then decide whether the low gains of second sibs are due to high pretest differential or to competition?

Because all the overlapping pairs experience competition, any differences in gains among the second sibs in these pairs must be due to something other than competition. We will divide the overlapping pairs into groups, according to the size of their pretest differential. If there are differences among the groups in the amount the second sib gains, we will know that these differences are due to pretest differential and not to competition between the sibs.

Table 2 shows the 13 pairs of overlapping sibs divided into three groups according to their level of pd. These three groups differ significantly with respect to the mean gains of the second sibs.[32] The pattern of differences is similar to the pattern for the entire sample of 25, shown in Table 1.

The evidence in Table 2 shows that a high pretest differential is associated with low gain of second sibs even when competition is held constant. We conclude that competition between the sibs is not responsible for the low gains of second sibs.[33]

<u>b. Inherent limits on IQ gain.</u> Our remaining hypothesis suggests that a child can be stimulated to only a limited amount of IQ gain within a given period. The younger sibling, having achieved most of his allowable increment before he entered the program, can gain only a few more IQ points during his first year of the program. We have no evidence by which to confirm or refute this hypothesis. It would be worth pursuing because of its obvious implications for the theory of cognitive development, but such an investigation would take us outside the scope of the Family Cognitive Profile Study.

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V. SUMMARY AND DISCUSSION OF RESULTS

Our study began with two questions, one about the validity of the statistical procedures of the VIP and the other about the importance the VIP ascribes to the participation of the mother in the MCHP.

Our findings have supported the statistical procedures of the VIP. However, we have encountered methodological obstacles in investigating the role of the mother in the MCHP. So far we have been able to confirm only one of our four hypotheses relevant to this issue. Specifically, we were able to demonstrate that when the subject's mother has had prior exposure to the program, the subject enters the program with a higher pretest score than expected. For example, the second sib to enter the program has a pretest IQ about 8 points higher than the first sib. We called this difference between the pretest score of sib 1 and the pretest score of sib 2 the "pretest differential" and ascribed it to downward diffusion of the program from the older sib to the younger.

Further investigation of the pretest differential revealed that it occurs mainly when the gains of the first sib are higher than average during Program I. This finding suggests that circumstances which promote IQ gain, such as the mother's skills at stimulating verbal interaction with the child, also promote downward diffusion.

The existence of downward diffusion suggests that the mother learns skills from the MCHP which she uses in her interaction with all her children, even those not enrolled in the program. Thus a child who is not enrolled in the program may gain IQ points because of his mother's exposure to the program. On the other hand, he may gain IQ points because he is informally exposed to the program when he participates in the home sessions intended for his older sibling. If this is so, downward diffusion could be the result of "child exposure" to the program rather than of "mother exposure". Up to now we have not been able to discover whether downward diffusion is more influenced by "mother exposure" or by "child exposure". Whatever we may discover, it is certain that a child who is not enrolled in the program may nonetheless benefit from it. This is the most important finding of the study.

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VI. PLANS FOR THE COMING YEAR

Most of the questions generated by the Family Cognitive Profile Study have now been examined. However, some important problems remain to be investigated.

In the coming year, our first task will be to test Hypothesis 4. This hypothesis predicts that first sibs are helped to retain their gains by the continued involvement of their families with the Mother-Child Home Program. The data needed for testing this hypothesis have been available in sufficient quantity since the completion of Follow-up D (1972-73).

The new data gathered in 1972-73 will also allow us to compare the IQ scores of 15 pairs of first and second sibs, each of whom had two years experience with the program. From this comparison we hope to discover whether downward diffusion has any lasting effects on the IQs of second sibs.

Because some of our past conclusions arise from post-hoc analyses of the data, a replication of the study is essential to validate our findings. In 1972-73, eleven second sibs entered the program. We expect that we will have enough additional second sibs in 1973-74 to replicate the Family Cognitive Profile Study.

These new data will also be used to discriminate between the relative importance of "mother exposure" and "child exposure" in determining downward diffusion.

After completing the above tasks, we will prepare a report of the study for publication.

Table 1

Gains in Program I according to level of pretest differential

	N	gain of sib 1	gain of sib 2	pretest differential
High pd	7	20.0	3.1	25.3
Moderate pd	9	21.4	21.9	11.7
Low pd	9	16.6	10.4	-8.7

Table 2

Gains in Program I within the "overlapping" group, according to level of pretest differential

	N	gain of sib 1	gain of sib 2	pretest differential
High pd	5	21.6	3.6	27.0
Moderate pd	4	21.8	15.3	12.8
Low pd	4	21.3	10.3	.2

FIGURE 1 sib 1 gains x sib 2 gains

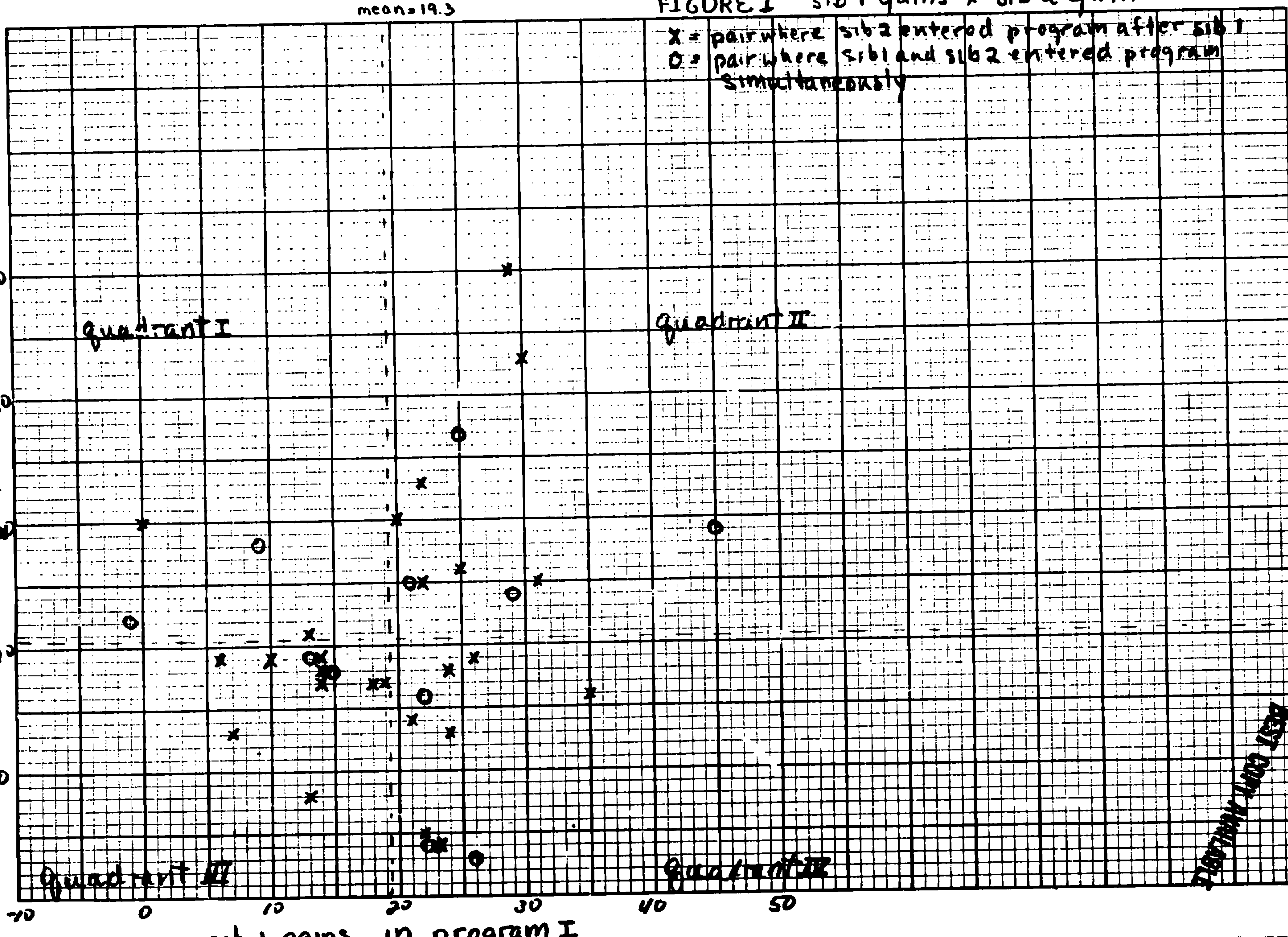

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FIGURE 2 sib 1 pretest x sib 1 gain N=36

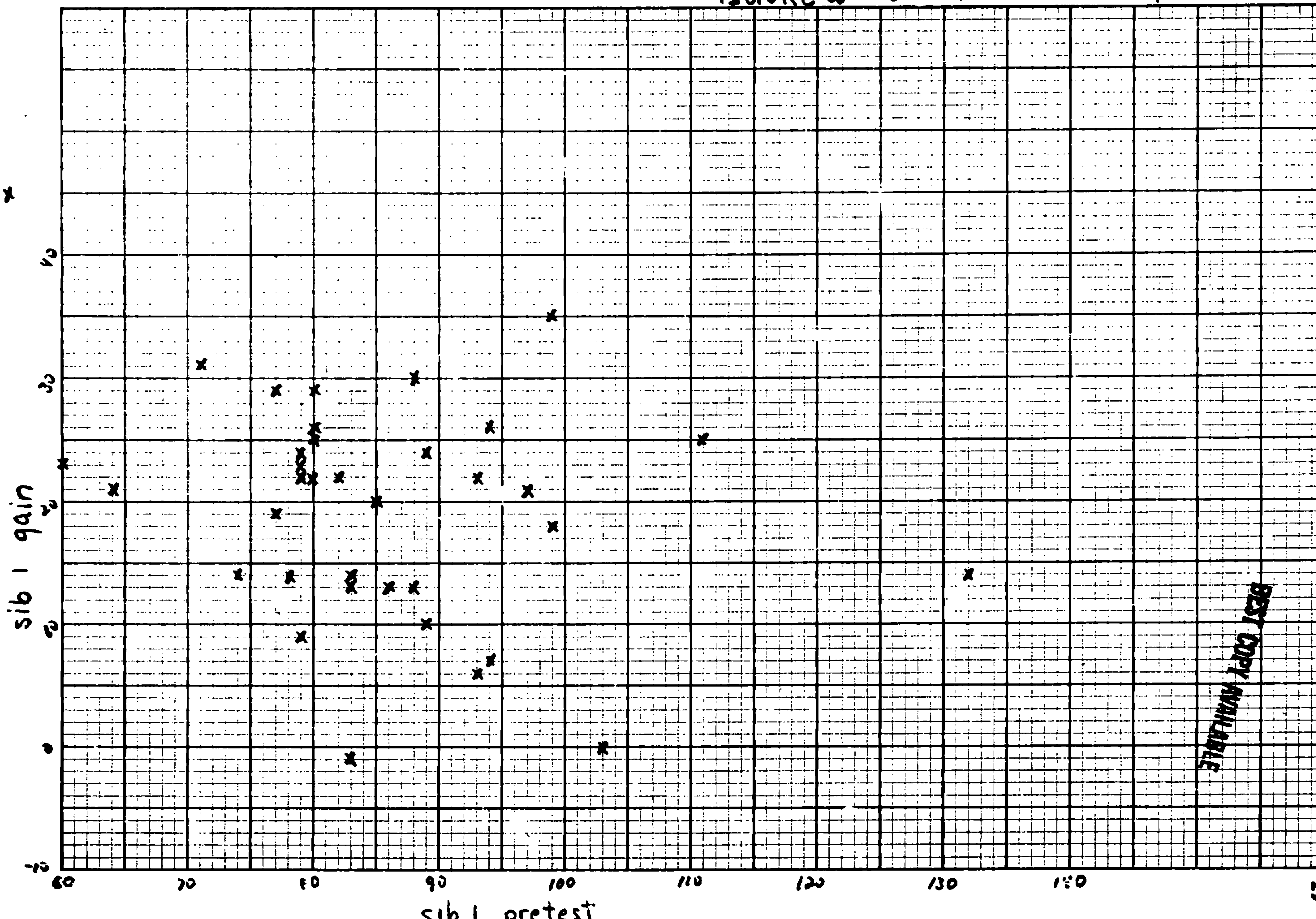

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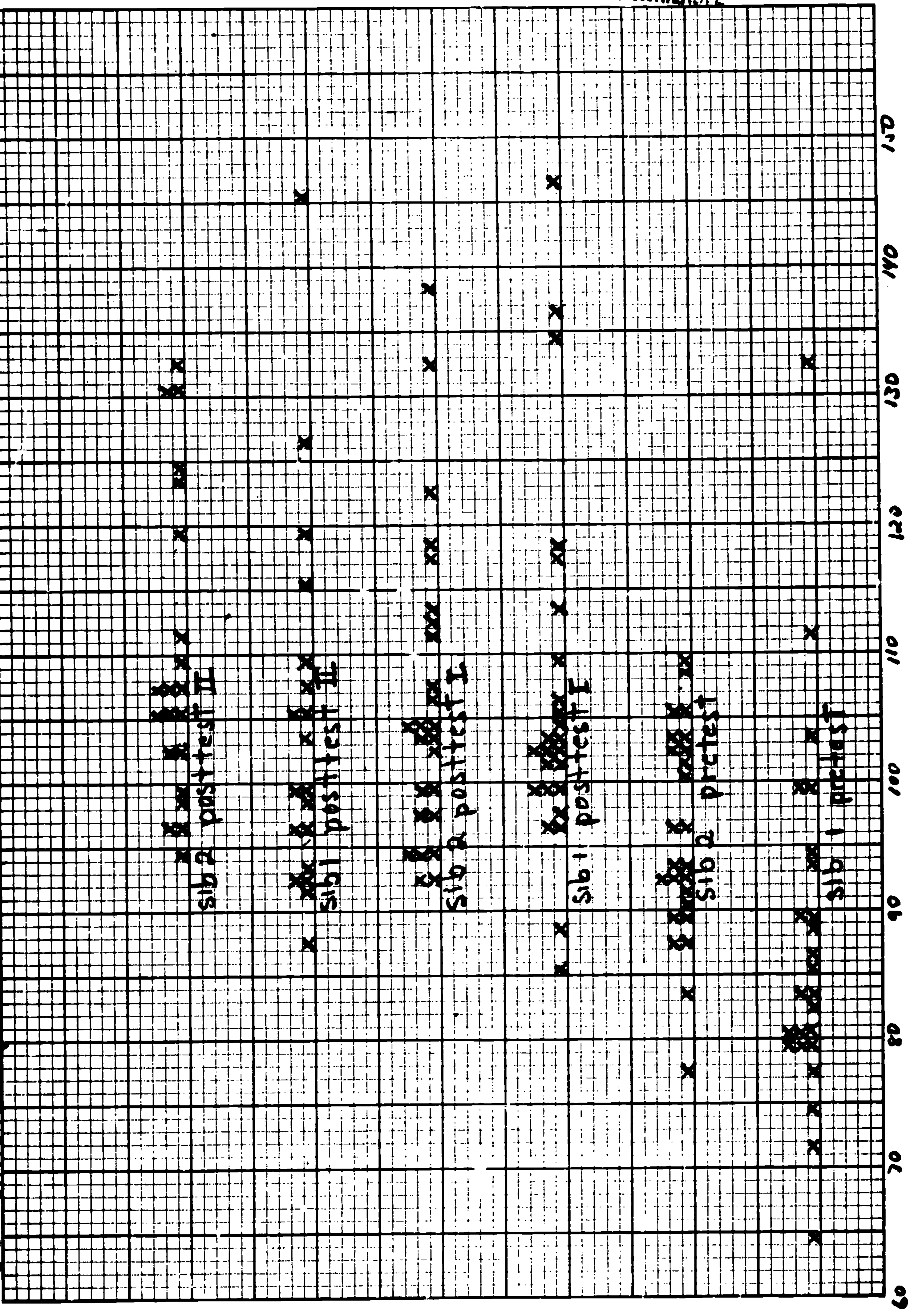
FIGURE 3
Distribution of pretest and posttest scores



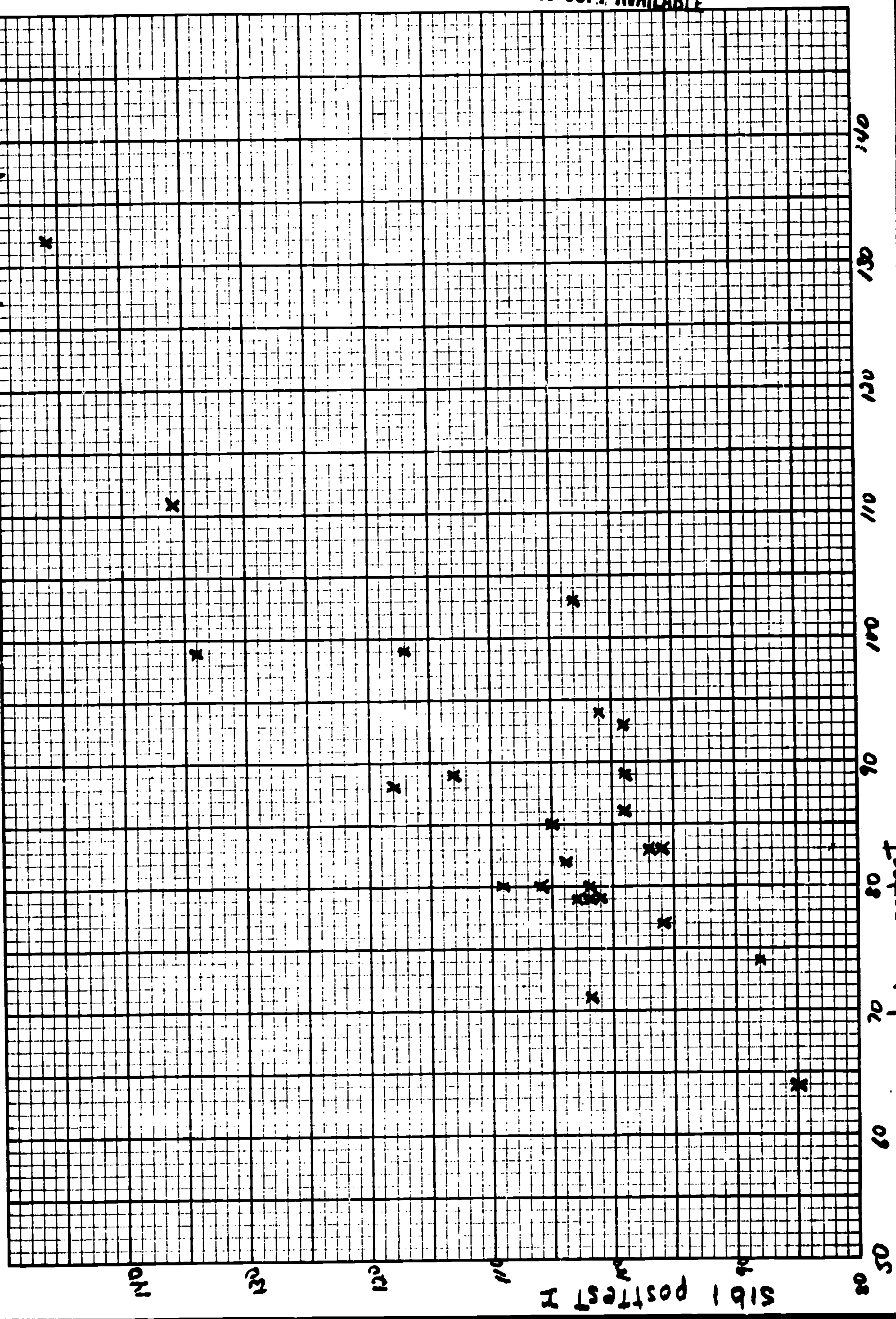


FIGURE 4 sib1 pretest x posttest I N=25

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FIGURE 5 sib 2 pretest x posttest I N=25

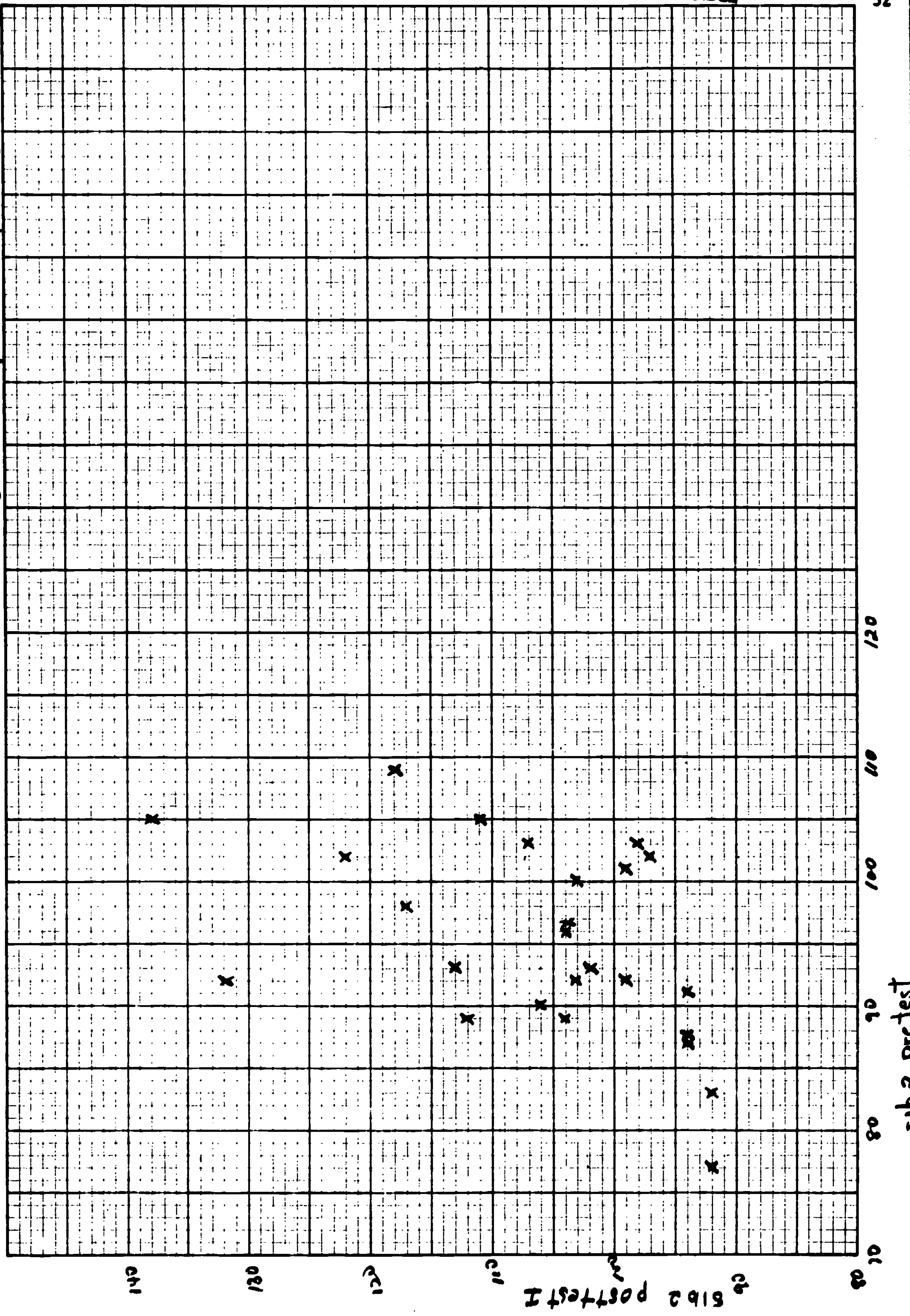

Figure 6 sib 1 gain x pd N=25

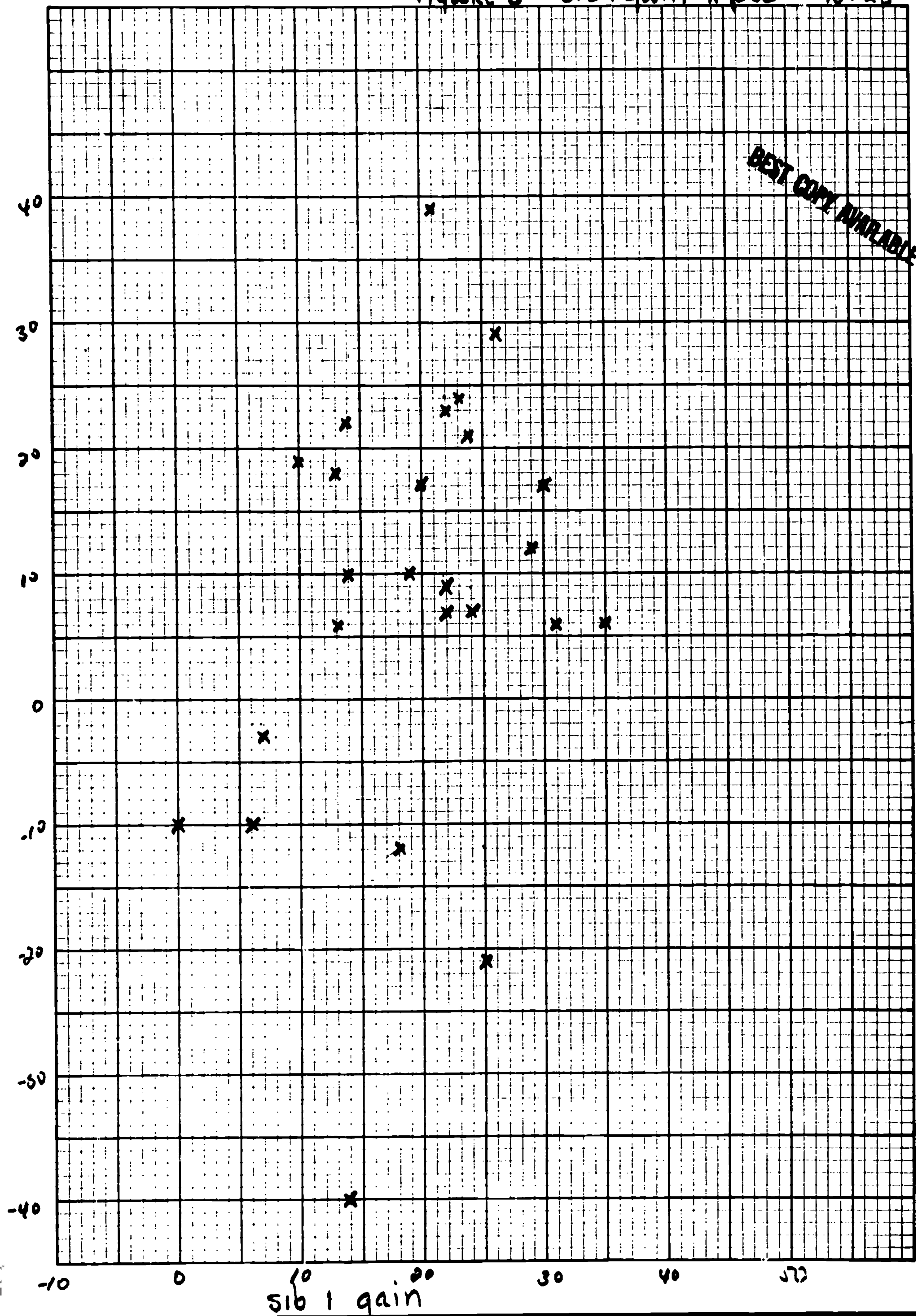

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figure 7 sib 2 gain x pd N=23

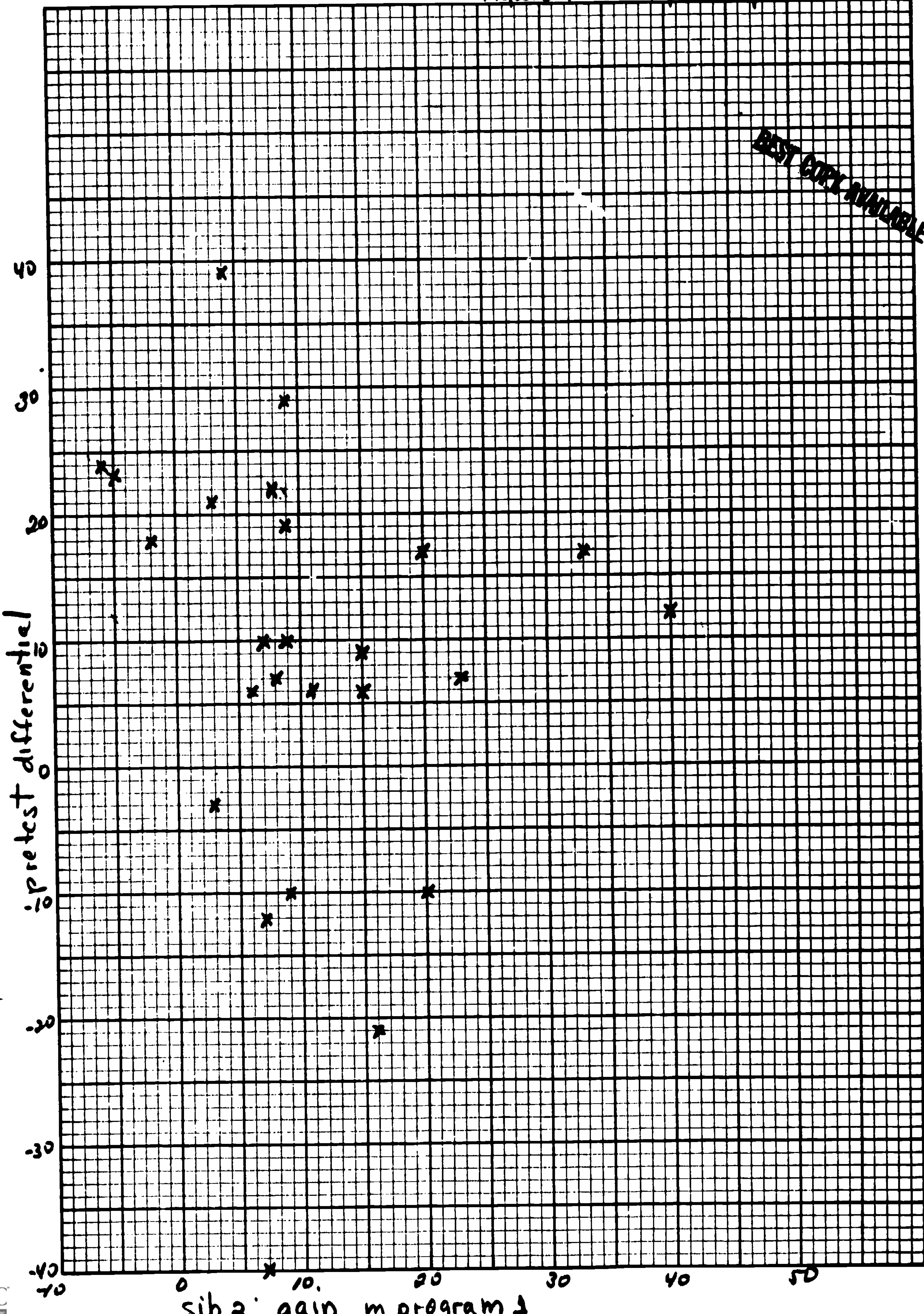

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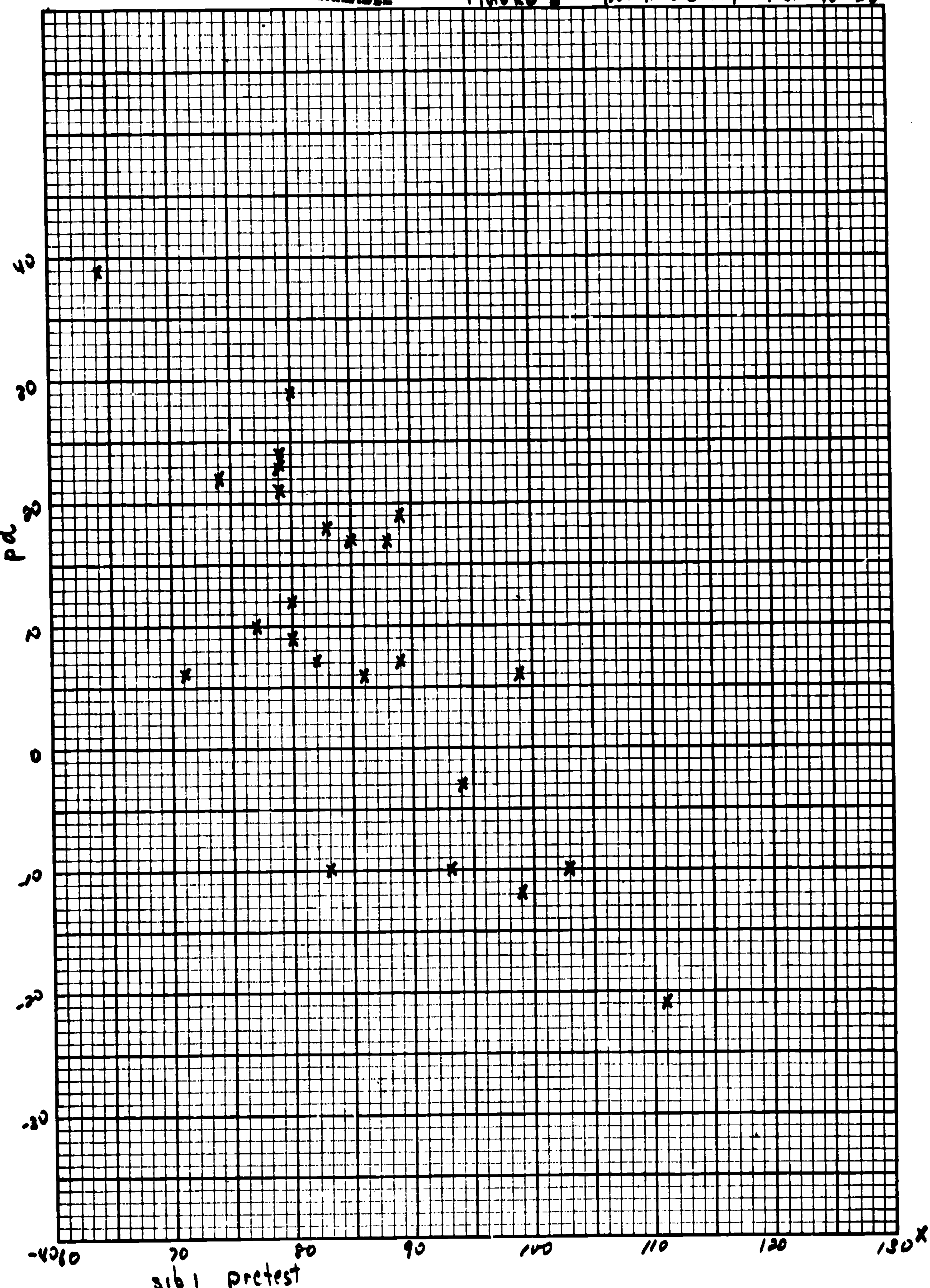
FIGURE 8 pd x sib 1 pretest N=26



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Example of IBM card format for data from the Family Cognitive Profile Sheet

Columns	Data
1-7	First four letters of subject's surname
8-13	Case number
14-17	General IQ pretest score
18-21	Verbal IQ pretest score
22-25	General IQ posttest I score
26-29	Verbal IQ posttest I score
30-33	General IQ posttest II score
34-37	Verbal IQ posttest II score
38-41	General IQ Follow-up I score
42-45	Verbal IQ Follow-up score
46-49	General IQ Follow-up II score
50-53	Verbal IQ Follow-up II score
54-55	Treatment condition
56-57	Numbers of years in experimental program
58-60	Age of entry into program
61-62	Number of older sibs from family in program, including self
63-64	Number of sibs in program from family, including self
65-66	Irregular program experience
67-68	Index of mother exposure to program at present
69	Index of mother exposure to program at Follow-up II

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Verbal Interaction Project
Family Service Association of Nassau County, Inc.
Mother-Child Home Program

Profile of Family Member Interaction's with Mother-Child Home Program

INFORMATION ON PRIMARY INTERVENER LIVING IN HOME:

Name: ______________________ # years of contact (any kind) with MCHP: ________

years as primary intervener in experimental program: ______ # years as TD: __________

children in home who completed experimental program: ______________________

INFORMATION ON CHILDREN LIVING IN HOME:

Children who have never been tested by MCHP

Name	Relation to Primary Intervener	Birthdate	School Problems(details: grade, type and treatment, if any)
1.			
2.			
3.			
4.			
5.			

Children who have been tested at least once by MCHP:

Child 1. Name: ______________________ Case#: ______________

Relation to Primary Intervener: ______________________

Type of program experience. ______________________ #years completed: __________

Atypical intervention?: ______________________

Test results:	Date	Gen IQ	Verb IQ	CBT	Achievement(VIP)	Achievement(School)
Pretest						
Posttest 1						
Posttest 2						
FU 1						
FU 2						
FU 3						
FU 4						

Child 2. Name: ______________________ Case #: ______________

Relation to Primary Intervener: ______________________

Type of program experience: ______________________ # years completed: __________

Atypical intervention?: ______________________

Test results:	Date	Gen IQ	Verb IQ	CBT	Achievement(VIP)	Achievement(School)
Pretest						
Posttest 1						
Posttest 2						
FU 1						
FU 2						
FU 3						
FU 4						

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Verbal Interaction Project
Family Service Association of Nassau County, Inc.
Mother-Child Home Program

Profile of Family Member Interaction's with Mother-Child Home Program

Child 3. Name: ____________ Case#: ________ Birthdate: ________

Relation to Primary Intervener: ____________

Type of program experience: ____________ #Exp. Years completed: ________

Atypical intervention?: ____________

Test results:	Date	Gen IQ	Verb IQ	CBT	Achievement (VIP)	Achievement (School)
Pretest						
Posttest 1						
Posttest 2						
FU 1						
FU 2						
FU 3						
FU 4						

Child 4. Name: ____________ Case #: ________ Birthdate: ________

Relation to Primary Intervener: ____________

Type of program experience: ____________ #Exp. years completed: ________

Atypical intervention?: ____________

Test results:	Date	Gen IQ	Verb IQ	CBT	Achievement (VIP)	Achievement (School)
Pretest						
Posttest 1						
Posttest 2						
FU 1						
FU 2						
FU 3						
FU 4						

Child 5. Name: ____________ Case #: ________ Birthdate: ________

Relation to Primary Intervener: ____________

Type of program experience: ____________ #Exp. years completed ________

Atypical intervention?: ____________

Test results:	Date	Gen IQ	Verb IQ	CBT	Achievement(VIP)	Achievement(School)
Pretest						
Posttest 1						
Posttest 2						
FU 1						
FU 2						
FU 3						
FU 4						

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Footnotes

1. We chose the gain in the first year rather than the gain over both years because the number of sibling pairs where both sibs had two program years is quite small.

2. The statistical significance of the IQ gains of VIP subjects is very high and has been repeatedly demonstrated over six years. It is very unlikely that even a strong correlation between sibs' gains would have such a large effect on the significance level as to shake our confidence in the effectiveness of the MCHP. First, the proportion of subjects who are not the first in their family to enroll in MCHP is small (less than 25%). Second, most of the second sibs entered the program in a later year than their corresponding first sibs. Since t-tests are done on a yearly basis, the dependencies among sibs thus separated in time will not affect any individual t-test. However, the dependency between sibs will then affect the independence of the several t-tests, which have been treated as independent replications by the VIP. If there is dependency in the data across the years, the replications are not independent. Once again, the consequences for our assessment of MCHP effectiveness are likely to be minimal.

If the consequences of dependency are likely to be minimal, we may ask why we pursue the question. First, we want to have a cogent answer for critics who may bring up this question, and second, the issue has interesting theoretical implications.

3. A nonsignificant correlation does not exclude the possibility of a dependency which is non-linear in form. The correlation coefficient measures only straight-line relationships.

4. In Hypotheses 2,3, and 4, the child's IQ gains are related to the mother's experience in the program. The mother's experience was quantified in terms of an "index of mother exposure". Such an index was thought necessary in order to place all the data on a continuum, because a mother's exposure to the program could be composed of several different types of experiences, and in differing amounts. She could have several children in the program (as many asfour children from one family have been in the program). She could

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join the program as a Toy Demonstrator. She could have several children coming to the program center for follow-up testing. She could have children being tested as controls. To equate these experiences for purposes of comparison, the investigator devised an index of mother exposure. There were several versions, ranging from a simple dichotomy (no previous contact/some previous contact) to several more complex types. We started with the simplest index, since it is the most understandable and requires the fewest assumptions, though it is also the most wasteful of information. We felt that refinements could be added as necessary and desirable.

5. If we expect diffusion of program effects to siblings who are experimental subjects, we must also expect diffusion to siblings who receive no direct treatment. There is very little information in the Verbal Interaction Project about the IQs of untreated siblings. There have been a few instances where first sibs were control subjects and younger siblings later entered the program. This happened in two control groups. First, the original control group for the Verbal Interaction Project (designated C_1) was sacrificed in the interest of human relations and was enrolled in the program the second year it was in operation. Several of these subjects have had second sibs in the program. Second, the original plan of the VIP was to have a set of ten four-year-olds in the program. These subjects were pretested and then eliminated from the program because it was discovered that they were also enrolled in a Headstart program. In 1971 the VIP decided to do follow-up testing on these subjects as a natural control group (designated C_4). Eight of these subjects had younger sibs who were experimental subjects.

The C_1 group cannot be used to study upward diffusion because by the time the second sib enrolled in the program the first sib had also received treatment. The C_4 group is too small to make a meaningful comparison between subjects with younger sibs in the program and subjects without younger sibs in the program.

The VIP is no longer accepting third and fourth sibs into the program, but these younger sibs are being tested on the same schedule as experimental subjects. Four such children were tested in the year 1972-73. Eventually

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these subjects may provide data useful for the study of diffusion.

At the beginning of the program, before the details of the family relationships among experimental and control subjects were clear, it was hoped that a direct study could be made of diffusion to untreated siblings. Since the necessary data are not available, our best evidence for the existence of diffusion effects must come from siblings who have been experimental subjects. For instance, if we find a statistically reliable difference between the pretest scores of sibs, we may take this as indirect evidence that program effects do diffuse to untreated younger sibs of program subjects.

6. Some children who were pretested did not stay in the program through the first year and therefore received neither posttests nor follow-up tests.

7. In 1967, four-year-olds were also pretested but were excluded from the program after it was discovered that many of them were enrolled in a Headstart program. These four-year-olds were later included in follow-up testing as a retrospective control group (C_4).

8. Form #136: Profile of Family Member Interactions with MCHP. (See the example on page 37).

9. These pairs exclude third and fourth sibs, and also families where the circumstances were considered so atypical as to change the basic relationships between the program, the mother and the child. An example is a family where the mother attended home sessions with the first child and the grandmother attended home sessions with the second child.

10. The significance levels of the correlations quoted in this report were assessed by a method of randomizing which allows us to avoid making assumptions about statistical characteristics of the sample.

11. The lack of data points in Quadrant I partially confirms Hypothesis I, in spite of the overall low correlation.

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12. If the pretest differential is the result of downward diffusion, then the pretest differential should occur only when the second sib entered the program later than the first sib. This is so because, in order to be affected by diffusion, the pretest of the second sib must take place after the first sib has been exposed to the program. When the sibs enter the program simultaneously, downward diffusion, and hence pretest differential, is precluded automatically. Eleven of our 36 second sibs entered the program the same year as their older sibs did. We have called these eleven pairs "simultaneous pairs". In our further examination of the pretest differential and its consequence for IQ gain, the 11 simultaneous pairs were excluded from our sample, leaving an N of 25.

13. We substantiated these observations by the following statistical procedure. We used the "cum rule" (Bryson and Phillips, 1973) to divide the distribution of the pretest differential objectively into high, moderate and low categories. The Kruskal-Wallis analysis of variance by ranks was used to test the hypothesis that there is an overall difference in IQ gains among the second sibs in the three groups (N=7,9,9). The hypothesis was supported at the .05 level. The Mann-Whitney U test was then used to test the difference between the high pd and the moderate pd groups. This difference was significant at better than .01. The mean gain of first sibs in each group is shown in Table 1.

14. Excluding simultaneous pairs.

15. We attempted to get an independent estimate of pretest IQs of second sibs in order to measure the correlation between sibs' gains independent of downward diffusion. Our independent estimate was based on the assumption that siblings' pretest IQs are more similar to each other than to other children's IQs. This assumption was not well founded. We based the assumption on the observation that, in the control groups of simultaneous pairs, the mean pretest score for first sibs is the same as the mean pretest score for second sibs. We then mistakenly generalized this finding to individual pairs of sibs. In fact there is no evidence that siblings in this program have similar IQ scores prior to contact with the program.

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16. The Wilcoxon matched-pairs signed-ranks test was used to compare the pretest scores on first sibs with the pretest scores of second sibs. The difference was significant at better than .01.

17. There were 145 experimental subjects whose mothers were new to the program. There were 31 subjects whose mothers were experienced in the program. We used the randomization test for two independent samples (Siegel, 1956, page 155) to test the differences between the pretest scores of these two samples. The difference was significant at better than .025.

18. The two samples are not independent of each other, so the similarity is not surprising. However, it does increase our confidence that results obtained from the sample of 25 pairs of sibs are representative of the entire sample of VIP subjects.

19. The sign test was used to compare the pretest scores of first and second sibs in the eleven simultaneous pairs. Six of the eleven pairs has a positive pretest differential. This proportion is not statistically significant.

20. These pairs came from three groups. Eight older sibs came from a group of controls (C_4) constituted retrospectively. These were the four-year-olds who were originally enrolled in the MCHP in 1967, pretested, and then dropped from the program. They were not tested again until 1971. The second sibs of these subjects were all experimental subjects. Three of the remaining pairs came from the second control group (C_2) constituted in 1967. The remaining three pairs came from the control group (C_3) constituted in 1969 to test the effect of providing toys without home sessions.

21. The sign test was used to compare the pretest scores of first and second sibs in the 14 control pairs. Eight of the fourteen pairs have a positive pretest differential. This proportion is not statistically significant.

22. A distribution of differences generated by random pairings of two samples such as the pretest scores of first and second sibs, should be approximately normal in shape if the pretest distributions are normal. IQ distributions are expected to be normal by definition, and our sample distributions are not markedly deviant from this expectation.

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23. We may ask ourselves how important is the difference between a correlation of .82 and a correlation of .50. This may best be understood in terms of the percentage of variance accounted for by the correlation. Variance is the way the individuals in a sample deviate from the mean of the sample. The mean posttest IQ score of the first sibs is 109.8. What makes any individual score differ from 109.8? Clearly it is the pretest score of the individual. The percentage of variance in posttest scores which is accounted for by pretest scores is the square of the correlation between the pretest and posttest scores. In this case, over 67% of the posttest variance is controlled by pretest scores.

How much of the variance among the posttest scores of the second sibs is controlled by their pretest scores? The square of .50 is .25, or 25% of the variance. Thus the pretest score is <u>not</u> the main thing that is determining the posttest score of these subjects. The difference between a correlation of .82 and a correlation of .50 is the difference between the majority voice and the minority voice in the allocation of posttest scores.

24. Nineteen first sibs and twenty-one second sibs received Program II, including subjects who completed Program II in 1973.

25. This analysis is made possible by the additional data gathered from program testing and follow-up testing during the year 1972-73.

26. We explored the year of entry of the first sib as a possible factor controlling the size of the pretest differential. Our interest in this factor is secondary because it is linked to pd only through the supposed differences in gains among children who entered the program in different years. Gains of first sibs were already established as a source of variance in pd. The topic of differences among years of entry is of interest in itself but is not germaine to our inquiry.

We also looked at the relationship between pd and the pretest score of the first sib. There is a high negative correlation ($r = -.88$) between these two measures. This correlation is largely a statistical artifact and holds equally for the control groups. It therefore has no bearing on downward diffusion. In spite of this, the relationship is interesting to us because it does account for most of the variance in the pretest differential. It helps us to understand, for instance, the existence of negative pds. It does not, however, shed light

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on the existence of high positive pds, because the high pd values are associated with the same range of sib 1 pretest scores as are the moderate pd values (see Figure 8).

27. The difference between the pretests of pairs when sib 1 gains less than average was tested by the sign test. There were 11 pairs, of which 5 had positive differences. The probability of finding this proportion by chance is .50.

28. The difference between the pretests of pairs when sib 1 gained more than average was tested by the sign test. There were 14 pairs, 12 of which had positive differences. This proportion is significant at .006.

29. This policy is well advised, since the child learns in the context of family life, and the learning which the program seeks to enhance takes place not in a special laboratory-pure session isolated from family life but in the context of family interaction. The more the program is brought into that context, the more effective it will be.

30. It has been suggested that the program should control for child exposure by teaching concepts appropriate to the developmental level of the older sib but inappropriate to the developmental level of the younger sib. This procedure would shield the younger sib from the effects of the program. It would require a very large investment of time and manpower because it would require new data to be collected. In addition this procedure would raise another problem. The MCHP does not teach age specific concepts. Rather it demonstrates techniques of interaction with children which are appropriate at any age level. Herein lies one of the great strengths of the program, for it is equally appropriate for any child, regardless of his prior experience and individual development, and for any mother, regardless of her personal resources. Departing from this curriculum would be tantamount to creating an entirely new program.

It has also been suggested that one could discriminate between the effects of mother exposure and the effects of child exposure by removing the second sib from the home sessions before he is formally enrolled.

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This approach would eliminate "child exposure" as a factor contributing to diffusion effects. However, it would violate a basic premise of the MCHP. Insofar as possible, the program adjusts to the home, not the home to the program. The wide acceptance of the program rests in part on the care with which this policy has been carried out.

Moreover, the younger child is a real and very important part of the environment of the experimental subject. One of the important things a mother of two young children has to learn is to manage both simultaneously without shortchanging either. Home sessions without the younger sib are not realistic, nor would they set an example of what the program hopes to promote in the home, namely interaction and verbal communication among all family members. It would be difficult to draw conclusions about the operation of the MCHP from results based on an experimental manipulation which removed a younger sib from home sessions.

31. Explanation b. is not identical to the original hypothesis that the low gains of the second sibs are the result of their high pretest scores. A subject may gain in IQ through diffusion without achieving a high pretest IQ; conversely, he may have a high pretest IQ without gaining anything from diffusion. We originally attributed the low gains of second sibs during Program I to the high values of their pretest scores; in Explanation b. we are attributing the low gains to the increase in IQ brought about by diffusion.

32. The Kruskal Wallis one way analysis of variance by ranks showed the groups to differ significantly ($p \quad .05$) with respect to the gains of second sibs.

33. This conclusion sheds no light on the low gains of second sibs in simultaneous pairs. Their low gains are due neither to diffusion nor to competition. We are at a loss to account for them.

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